C-AD

Radiation

Safety

Committee

Issued: August 29, 2006

Minutes of Radiation Safety Committee of May 31, 2006

Subject: Review of Fault Study for RD1/2 as Critical Devices for NSRL

Present: D. Beavis, L. Ahrens, K. Yip, A. Rusek, I.-H. Chiang, J. Reich, J.W. Glenn, R. Karol, W. MacKay, P. Pile, A. Etkin, P. Bergh, D. Phillips, N. Kling, K. Gardner, and E.T. Lessard

The committee reviewed the potential fault dose in the target room if RD1/2 are used as critical devices for NSRL (see attachment 1).

The committee did NOT recommend the use of RD1/2 as critical devices if NSRL was operating concurrently with BLIP or the high intensity source.

The committee did recommend use of RD1/2 as critical devices for the following conditions:

1) **Any ion operations from the tandem with Linac injection locked off.**
2) **Polarized protons from the Linac with the high intensity source locked off (pending review of the potential fault dose).**
3) **Protons from the high intensity source with approved methods to reduce the beam intensity (pending review of the potential fault dose and an established maximum beam intensity).**

Discussion

The results of the fault study were consistent with the simulations (see attachment 1). A chipmunk was used to measure the dose in the beam area in the target room. The beam is smaller than 1000 cm**2 so a reduction factor was utilized as discussed in OPM 9.11. The "reduced" dose equivalent was 20.8 mrem/10**14 protons. The Booster ASE is 5.4*10**17 GeV in one hour. At an energy of 1 GeV this corresponds to 1.5*10**14 GeV-n/s. Thus a maximum fault dose could be 31 mrem/s or 111 rem/hr.

The time for a local chipmunk to stop such a fault depends on the response time of the chipmunk to larges dose rates and the time for the interlocks and the critical devices to stop the beam. A Booster chipmunk was interlocked manually to measure the time for the interlocks to provide protection (see attachment 2). The two TtB beam stops closed in 0.85 seconds. The LtB beam stop LTB2 closed in 0.85 seconds and the LtB beam stop

LTB1 closed in 2.25 seconds. The minimum recommended time for a chipmunk response to large doses is 0.65 seconds (see attachment 3). Using a chipmunk response time of 1 second we arrive at a total duration of a fault of about 1.85 seconds. The second LtB beam stop would allow faults to have duration of 3.25 seconds if LTB2 were to fail.

Based on these numbers the maximum "reduced" dose equivalent in a fault would be 57 mrem (101 mrem if LTB2 fails).

The target room is a radioactive materials area with TLD required. An unplanned exposure of more than 100 mrem would be a reportable incident.

Three chipmunks at NSRL can detect beam striking RD1/2 with varying degrees of sensitivity. The table below lists the chipmunk, its interlock level, and the rate for 1 GeV protons/s and the protons/hr hitting RD1/2 corresponding to the interlock level:

Chipmunk	Interlock Level (mrem/hr)	Protons/hr	Protons/s
NM133	20	4.65*10**12	1.2*10**9
NM134	20	8.9*10**13	2.5*10**10
NM132	2.5	5.5*10**14	1.5*10**11

NSRL has operated concurrently with BLIP for a total of 20 weeks. During this time there has been no BLIP pulses inadvertently delivered to NSRL. In addition, there have been no interlocks of the AGS B15 current transformers by BLIP pulses delivered to the AGS. There is no knowledge of BLIP pulses being delivered to the Booster, but such an occurrence could have gone unnoticed by operations for a few isolated pulses.

For the large faults discussed above 100 rem/hr (10**14 protons/s on RD1/2 at 1 GeV) the following has to occur:

1) The beam permit fails (used as an administrative control an not part of the ACS).
2) The front end of NSRL has to be retuned.
3) The downstream end of NSRL has to be retuned.
4) BLIP pulses have to be delivered to the Booster and accelerated.
5) The booster must be operating at its ASE.

For exposure to exceed 100 mrem in such a fault three chipmunk in the redundant interlocks must also fail.

Several committee members were not comfortable preventing such large potential faults with chipmunks and administrative processes. Therefore, the use of RD1/2 as critical devices with concurrent operation of BLIP or high intensity proton operations was not approved.

It was suggested that it might be possible to supplement the chipmunks with the new NMC units to prevent a common type or error from defeating the radiation detectors. This option may be discussed at a future time.

The committee recommended that the beam plug be used to supplement RD1/2. Thin stops such as vacuum valves are not suitable for the high-energy portion of the beam. During the measurements it was attempted to transport any elastic scattered protons from the vacuum box but was not successful. Calculations on the energy deposition into the beam plug will need to be conducted in order to determine under what conditions it might be damaged. **(Ck-NSRL-all-fy2007-484).** It is expected that the beam plug would be allowed to move at the same time that RD1/2 in being tuned on/off. The intent is for the beam permit to stop beam from striking the beam plug. Booster magnet D6 is not allowed on if the beam plug is in. The use of the beam plug may require changes to other modes of operations.

The committee chair noted that he has asked the liaison physicists for the Booster and the U line to address whether Booster extraction and AGS extraction have any potential for single scatter dose to areas that can be occupied. These were logged in e-mails on May 18, 2006 as:
Booster extraction **(CK-Booster-all-fy2007-482).**
AGS extraction **(CK-AGS-all-fy2007-483**).

Attachments (file copy only)

1) A. Rusek, I.-H. Chiang, and P. Pile, Memo on " NSRL Fault Study #3 (C-A fault study 218) Results", May 19, 2006.

2) J. Reich to D. Beavis, email on May 31, 2006.

3) J. Geller to D. Beavis, Memo on March 2, 1999, " Time to Chipmunk Interlock for Large Radiation Faults".

CC:

Present
RSC
RSC Minutes file
RSC NSRL File